SOUND PRODUCTION BY A LARVA OF CYBISTER (*DYTISCIDÆ*)

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In July last, I collected a live larva of a beetle belonging to the Dytiscidæ family, from a small ditch of water in the neighbourhood of Halisahar in the district of 24-Perganas, Bengal, and had an opportunity of observing the interesting phenomenon of sound production by the emission of tracheal air through its meso-thoracic spiracles.

The larva was aquatic in habit and measured nearly 55 mm. in length. It seemed to me that the specimen was at the final stage of its larval life, judging from its rather long body.

The larva belongs to the genus *Cybister* and appears to be that of *Cybister confusus* Sharp, occurring in Bengal. It closely resembles *Dytiscus* larva in the possession of a flat head, curved and pointed jaws, pigmented eyes and last two abdominal segments provided with hairs on their lateral edges. It is easily distinguished from the latter by the absence of a pair of styli at its posterior end. The *Dytiscus* larva hangs with its head downward keeping the tip of the abdomen above the surface of water and the styli help it in hanging. The tip of the abdomen contains a pair of spiracles. The *Dytiscus* larva takes up air by means of these spiracles. Portier (1911)[1] mentions that *Cybister* larvæ, in view of the absence of styli at their posterior end, cannot remain suspended from the surface of water or live long in deep water. The larva, as in the case of *Dytiscus* larvæ, possesses ten pairs of spiracles. Of these, two pairs belong to meso-and meta-thorax and the rest to the abdomen, each abdominal segment carrying one pair. The thoracic spiracles lie on the ventral side while the abdominal pairs except the last, are found on the lateral margins of the body. The last pair of abdominal spiracles is situated at the tip of the abdomen and being pushed up above the surface of water enabled it to have direct access to the atmosphere for respiration. All the other spiracles, due to the habit of larva in keeping itself under water, have little or no chance of coming in direct contact with air, and are non-functional so far as respiration is concerned and are regarded as closed. It must, however, be noted that the meso-thoracic spiracles are of considerable importance in the present case as they alone are concerned in the production of sound and clearly open to the exterior.

The larva was quite active during its captivity in the laboratory. It was placed in a petri dish half filled with water just enough to cover the body of the larva. The larva lived in this state for four days without taking any food and was afterwards killed. It obtained air for respiration by lifting the tip of the abdomen above the surface of water while its body rested upon its legs.

On the day following the capture I took up the live larva in my hand and was examining it under a hand lens. The larva apparently did not like the situation and attempted to wriggle out of my fingers. The consequence was that I had to tighten my grip over it and the larva responded by emitting a strange squeaking sound which indeed took me by surprise. To enquire as to the exact cause of the sound the larva was put back in water and I waited for an hour in vain to see if it would produce the same sound again. Then I teased it with a blunt mounted needle. The larva got irritated, jumped suddenly up by throwing its body into a curve and emitted at the same time the

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[1] Portier (1911), Recherches physiologiques sur les insectes aquatiques *Archiv. Zool. Esp.*, Ser. 5, vol. viii.

peculiar sound. The larva, of course, was forced to repeat the sound several times that day and there was no doubt about the production of sound by it. I observed that it could more easily be induced to make the sound if its abdomen was pressed hard or squeezed. It was also seen that the larva would produce the sound on being sufficiently disturbed without being hurt. The sound was given out on irritation whether the larva was in or out of water. It did not, however, make any noise when left undisturbed.

It is interesting to note that each time the sound was emitted the body was thrown into muscular jerks and the larva after emitting the sound at short intervals appeared fatigued.

The sound was of short duration but intense. Its intensity was such that my colleague, Mr. J. L. Bhaduri, who was working at the next bench a few feet away, came to mine attracted by the sound, and also began teasing the creature. The larva, however, had now its revenge. It drove its powerful pointed jaws right into his finger and drew blood, before Mr. Bhaduri could satisfy his curiosity. It was noticed further that a clear fluid of greenish brown colour ran out of the mouth of the larva when its jaws pierced Mr. Bhaduri's finger.

The object of making the sound probably is to frighten its enemies as it was produced only when the creature was in danger.

The larva was then examined by me for the mechanism of its sound production. A careful search under the binocular microscope did not show the existence of a stridulatory organ. As the production of sound other than by means of friction could be possible by the expulsion of a current of air from the trachea, the spiracles of the larva were subjected to careful observation by placing it under water and irritating it to emit sound. When the larva was placed under water on its dorsal surface and was forced to give out the sound, a small stream of air briskly bubbled out through water from the right spiracle of the mesothorax. The quick escape of air from the same aperture was also observed when the larva produced the sound on being poked without being hurt. But no bubbles of air could be seen escaping through thoracic spiracles during ordinary respiratory activity. Since the issuing of air through the right meso-thoracic spiracle was concomittant with the emission of sound there could be no doubt that sound was produced by the forceful expulsion of tracheal air through the spiracle. As sound in the present instance was caused by emission of air, the larva in this respect might be said to have a voice. Spiracles were further observed under binocular microscope after the larva was killed and put under water. Bubbles of air were found around the right as well as left spiracles of the meso-thorax adhering to their surfaces and glistening through water. On pressing the body of the larva for the first time after its death, bubbles of air were liberated from the meso-thoracic spiracles. The presence of air bubbles on the external surface of both right and left spiracles and disengagement of air from them indicate the possibility of ejection of air through both spiracles and not through a single spiracle as the actual observation of the live specimen disclosed. An explanation of why the air was seen to pass out of the right spiracle only might be found in the fact that during the observation the larva was forced to lie on its dorsal surface which limited the movement of its body in certain directions and thus the tracheal air was forced to pass out through a particular spiracular aperture of the meso-thorax.

As to the cause which leads to the forcing out of the tracheal air through the thoracic spiracles resulting in the emission of the sound, it may be mentioned again that just before or at the time of emission of the sound, the body of the larva was either thrown into powerful musclar jerks or its posterior region of the abdomen was artificially pressed. It is evident from this that the expulsion of air from the trachea was brought about by the muscular contraction of the body especially of the abdominal region. It may also be noted that the main trunks of tracheæ of *Cybister* larvæ as shown by Portier are peculiar in presenting a number of constrictions along their lengths.

It may be further mentioned that W. Alt (1912)[1] from his study of the structure and histology of respiratory system including spiracles of the *Dytiscus* larva suggests the possibility of sound production in the larva by the escape of air from the trachea through the thoracic spiracles which he shows as open.

[1] W. Alt (1912), Uber das Respiration system von *Dytiscus marginalis*, *Zeit. Wiss. Zool.*, xlix.

Miall (1912)[1], however, states these spiracles as closed. The tracheal air therefore when forced out possibly sets into vibration the membranes and hair lining the tracheæ near their spiracular openings, resulting in the production of sound.

It is also interesting to note that Wesenburg-Lund (1911–12)[2] reports the buzzing noise emitted by the winged forms of *Dytiscus* beetles. He points out that such buzzing noise is distinct from the note produced by the stridulatory organ when present. The buzzing sound, in his opinion, is caused by the emptying out of air from the tracheæ through the first pair of spiracles. The first pair of spiracles (prothoracic) of winged forms of the Dytiscidæ may be considered, in view of the shifting forward of spiracles during the developmental history of insects in general, to correspond with the first pair of spiracles (mesothoracic in position) of their larvæ. Thus there appears to be certain similarity in the physiology of production of sound among the larval and adult stages of the beetles of the Dytiscidæ family.

Further, the emission of air from the meso-thoracic spiracles of the larva coming as it does under the Dytiscidæ family has an important bearing on the disputed question of open or closed nature of spiracles of larvæ of the Dytiscidæ. The passage of air through the meso-thoracic spiracles clearly shows that the spiracles of the meso-thorax of this particular larva at this stage of its life are open to the exterior. The entry of water into tracheæ through the open spiracles is prevented from mainly by the action of surface tension as pointed out by Alt as well as by Wesenburg-Lund.

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[1] Miall (1912), Aquatic Insects.

[2] Wesenburg-Lund (1911–12), Biologische studien uber Dytisciden, *Biol. Suppl.* vol. v, *Series* v, *zur Inter. Nat. Rev. ges. Hydro. Bio, Hydrog.*, v.